Dec 16/99

# Final Exam, CMPT 393

Marks

18 1. The lifetime of a machine is 1 with probability 0.1, 2 with probability 0.2, 3 with probability 0.3, 4 with probability 0.2 and 5 with probability 0.2.

a) Find the probability that the machine survives 3 years.

b) Find the probability that a three year old machine fails in the fourth year.

c) Find the average time between replacements of the machine.

d) Use the results from part c) of this question to find the average number of replacements per year. Do not round!

e) Find the average number of replacements per year, given the machine is replaced after 4 years at the latest.

20 2. There are four plants which supply 3 warehouses. Plant one has a capacity of 10, plant 2 a capacity of 7 and plant 3 a capacity of 7. The demands of the warehouses are 5, 9, 6 and 4 for the warehouses 1, 2, 3 and 4, respectively. The cost of shipping from plant $i$ to warehouse $j$ are as follows

| | warehouse | | | |
|---|---|---|---|---|
| plant | 1 | 2 | 3 | 4 |
| 1 | 3 | 4 | 4 | 3 |
| 2 | 4 | 4 | 3 | 3 |
| 3 | 3 | 5 | 4 | 3 |

a) Use the North-West corner rule to find an initial allocation.

b) Find the $R_i$ and $V_j$.

c) Find the $c_{ij} - R_i - V_j$ for all nonbasic cells.

d) Reallocate to obtain an improved solution, and find the cost of this improved solution. Do not solve further.

25 3. A steel plant prepares the production schedule for the next three months. The capacity of the furnace is 3000 tons for each month, except that in month 2, the furnace must be serviced which takes 10 days, and the capacity is therefore reduced to 2000 tons. The steel is used to either produce T-bars or plated steel. The company employes 200 workers, and a worker can either handle 8 tons of bars or 6 tons of plated steel per month. The contributions to profit per ton of T-bars vary from month to month, and they are given as $r_{T1}$, $r_{T2}$ and $r_{T3}$ for month 1, 2 and 3, respectively. Similarly, the contributions to profit of plated steel for month $i$ are $r_{Pi}$, $i = 1, 2, 3$. The cost of holding a ton of T-bars is 2 per month, and the cost of holding plated

steel is 1.5 per month. Formulate the problem as a linear programming problem. Marks will be given for the definition of the variables and for a brief (one or two words) description of the restrictions. Also, state what programs or spreadheet-tools you would use to solve the problem.

18 4. A business has four telephone operators which take orders from cutomers. The time to place an order follows an exponential distribution with an average of 3 minutes. If, on the average, 64 calls arrive per hour, what is the probability that a call must wait, what is the average waiting time in minutes, and what is the probability that a customer must wait more than 2 minutes before gaining access to an operator. Assume that arivals are Poisson.

8 5. The economic order quantity (EOQ) is given as

$$\sqrt{\frac{2c_oD}{c_h}}.$$

a) If $D$ is the demand per month, what is $c_h$, and what are the units of $c_h$? (Give the units specifically, such as kilometers/hour or miles/hour or per second, depending on the situation).

b) If $D$ doubles, by how much percent does the EOQ increase?

6 6. An airplane can still load 20 tons of goods. There are six items which could be loaded, and each item has a weight $w_i$, and it leads to a revenue $r_i$. If this problem is solved as a dynomic programming problem, what are the states stages. What decisions have to be made at each stage? Be brief.

5 7. Given $s_i$ denotes the shodow price of resource $i$, $i = 1, 2, 3$. If one unit of a proposed product requires 3 units of resource 1 and 2 of resource 2, and none of any other resource, what is the minimum contribution to profit that would make prdouction of this product profitable.

100 The End